Space Weather Technical Forecast

Issued on Monday 2 December 2024 at 01:10 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of isolated M-flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, peaking with a C5.5 flare observed at 01/1622 UTC from AR3906. There are six regions currently visible, however these are generally simple with their magnetic configuration. The largest regions are AR3905 and AR3906 in the southwest disc. Both regions have remained largely inactive as they now approach the southwest limb, and have been showing signs of slight decay. However this could partly be due to their now increasing viewing angle. AR3912 is also of note, as the largest of the regions in the southeast disc, however this is also relatively simple. The other regions remain relatively stable and inactive.

No Earth-directed CMEs were observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds speeds, measured by ACE at L1, were background to slightly elevated, ranging 380-470km/s. Density was mainly average. The Interplanetary Magnetic Field (IMF) strength, Bt, was weak to moderate 5-11nT with the north-south component (Bz) also weak to moderate. Mainly northward directed initially, peaking at 8nT, but with increasing southward spells through the period, with a minimum of -8nT. Phi angle was initially negative (towards the Sun), but then rotated to be positive from 01/0600 UTC (away from the Sun). Geomagnetic was Quiet to Unsettled (Kp1-3).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at Background. High energy electron flux (greater than 2MeV) observed by GOES16 was Background. The associated 24-hour fluence remained well below Active. The 02/0000 UTC observed was 1.11e6 total pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected with a chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: A slow CME from a filament eruption on 27 Nov has a chance of a glancing impact on day 1 (02 Dec) or early day 2 (03 Dec), however only limited enhancements are expected. Otherwise in the absence of CME enhancement generally slow solar winds are likely to persist through the period, with background to slightly elevated speeds expected. Geomagnetic activity is expected to be mainly Quiet with isolated Unsettled intervals. Any CME enhancement

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day 1-2 (02-03 Dec) brings a chance of an Active spell and a slight chance of G1/Minor Storms intervals.

Energetic Particles / Solar Radiation: High energy protons are expected to persist at background with only a slight chance of responding as a result of any notable flare activity. High energy electron flux is expected to persist mainly at background with the associated 24 hour fluence remaining below the Active threshold.

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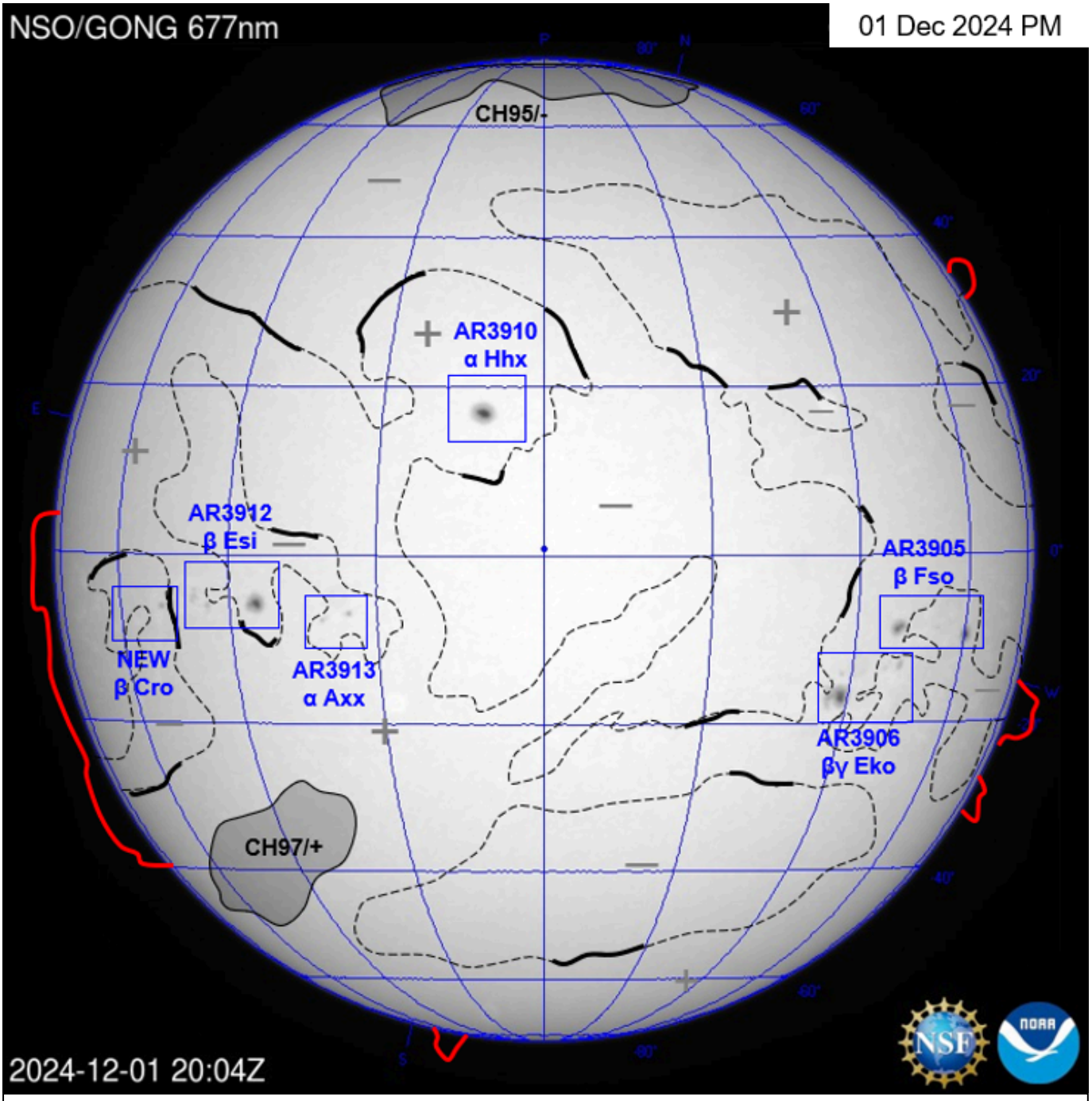
Figure 1: Solar Synoptic Map Valid 01/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

A CME associated with a filament eruption off the southeast disc around 27/1900 UTC, has a chance of giving a glancing impact, most likely during the second half of day 1 (02 Dec), perhaps early day 2 (03 Dec). However any impact is expected to be limited, perhaps bringing Unsettled to Active geomagnetic conditions, and only a slight chance of G1 Minor Storms.

Otherwise in the absence of CME enhancement generally slow solar winds are likely to persist through the period, with background to slightly elevated speeds expected. Some weak positive coronal hole enhancement is possible early in the period, this may just allow for brief spells of weak enhancement on days 1-2 (02-03 Dec), perhaps peaking around 450km/s. MOSWOC Enlil is currently slightly under-estimating the solar winds, but supports generally slow wind conditions persisting through the period, with the enhancement suggested into day 4 (05 Dec) viewed as low confidence.

Geomagnetic activity is expected to be mainly Quiet with isolated Unsettled intervals throughout. Any CME or coronal hole enhancement day 1-2 (02-03 Dec) brings a chance of an Active spell and a slight chance of G1/Minor Storm intervals.

Note, CME assessment is currently more challenging than usual due to the prolonged outage of available SDO HMI/AIA data with a corresponding lower confidence in geomagnetic storm risk.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	10	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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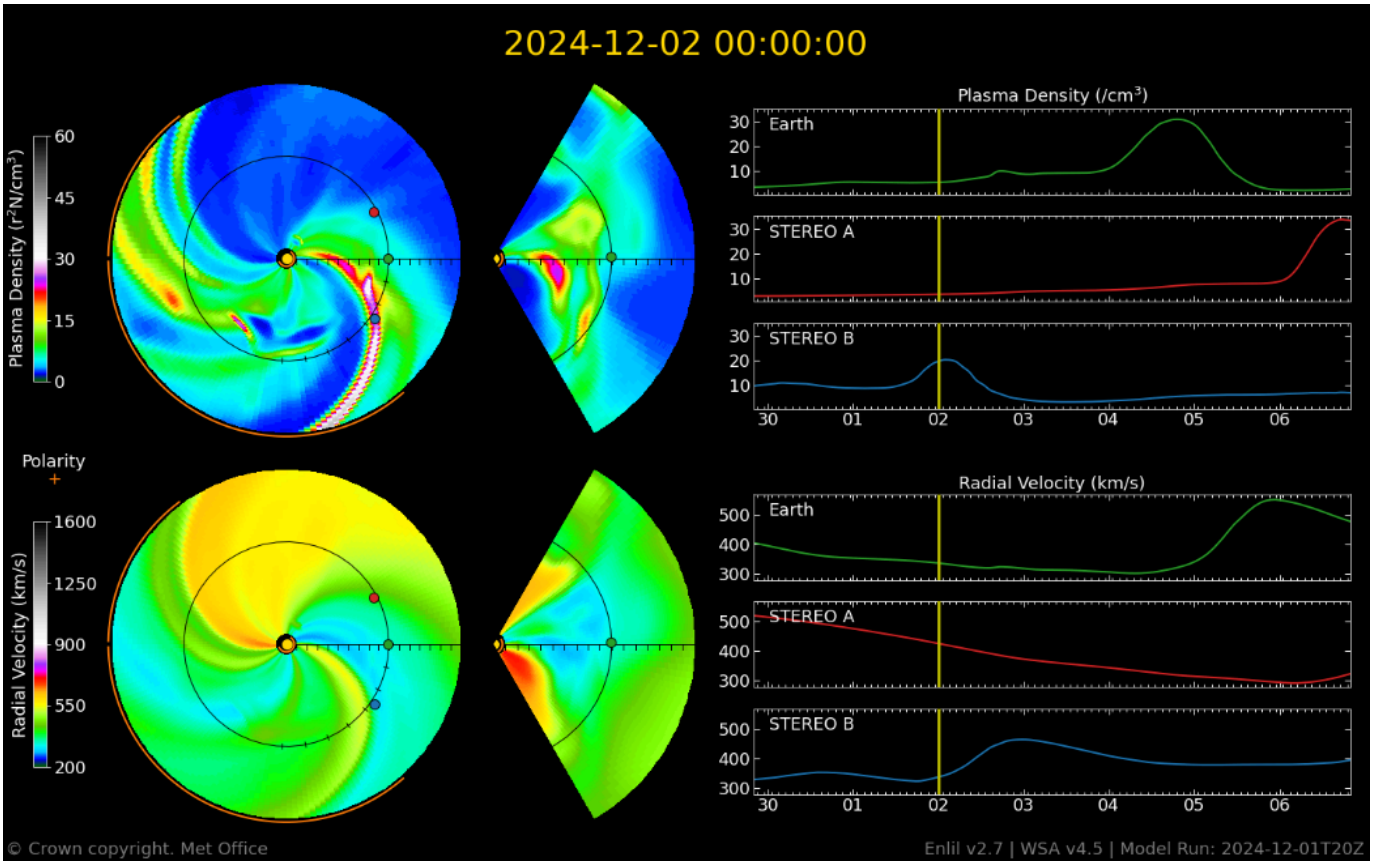
Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
28/11/2024 04:28	Partial	Filament	SE	390	02/12/2024 14:00 UTC	Moderate confidence of a glancing blow. Minimal enhancement expected.

Figure 2: Latest MOSWOC ENLIL output.



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Radio Blackouts - X-Ray Flares

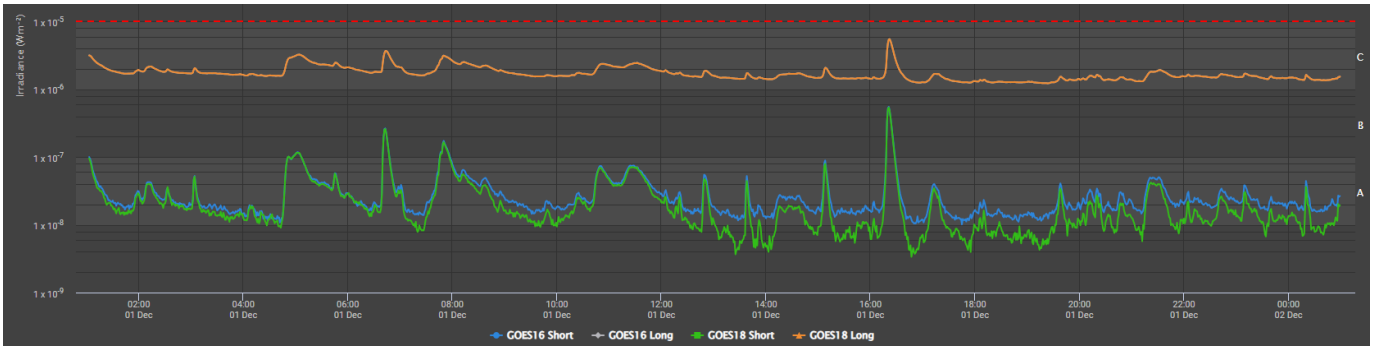
Of the six clearly visable sunspot regions, AR3905 and AR3906, which form a a moderately sized cluster in the southwest disc, and AR3912 in the southeast are the largest and most magnetically complex. Of these AR3906 is perhaps the most notable, with a more complex magnetic structure surrounding its large and irregular trailer spot. While AR3905 is a simpler open and mature group, this is close enough to AR3906 to have some magnetic connection and slightly increase the complexity on this portion of the disc. Despite this, these both remain largely inactive regions. AR3912 in the southeast is showing some increasing areal extent, however this remains a broadly simple bipolar group. Some magnetic looping is evident on the east limb of GOES SUVI 304 and 171, with a number of recurrent regions suggested to return during the coming days. However far-side GONG sounding products have very little signal for any notable regions returning, although this signal is lower confidence as potential returning regions approach the limb.

Overall Low to Moderate activity is expected with a slowly increasing chance of isolated M-class flares as likely oncoming regions add to the complexity on the disk.

Note, assessment of sunspot regions is currently more challenging than usual due to the prolonged outage of available SDO HMI/AIA data with a corresponding lower confidence in flare risk.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	40	40	50	50
Very Active	R3-R5 (X Class)	No	5	5	5	5

Figure 3: Latest 24hr GOES16/18 X-Ray trace.



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Solar Radiation Storms (High Energy Protons)

GOES-18 Proton flux is currently at background. While there are a couple of moderately sized regions on the better connected western disc, these are relatively simple and have remained largely inactive. Along with the other regions on the disc also being relatively small and simple, this only gives a slight chance of high energy proton enhancement through this period.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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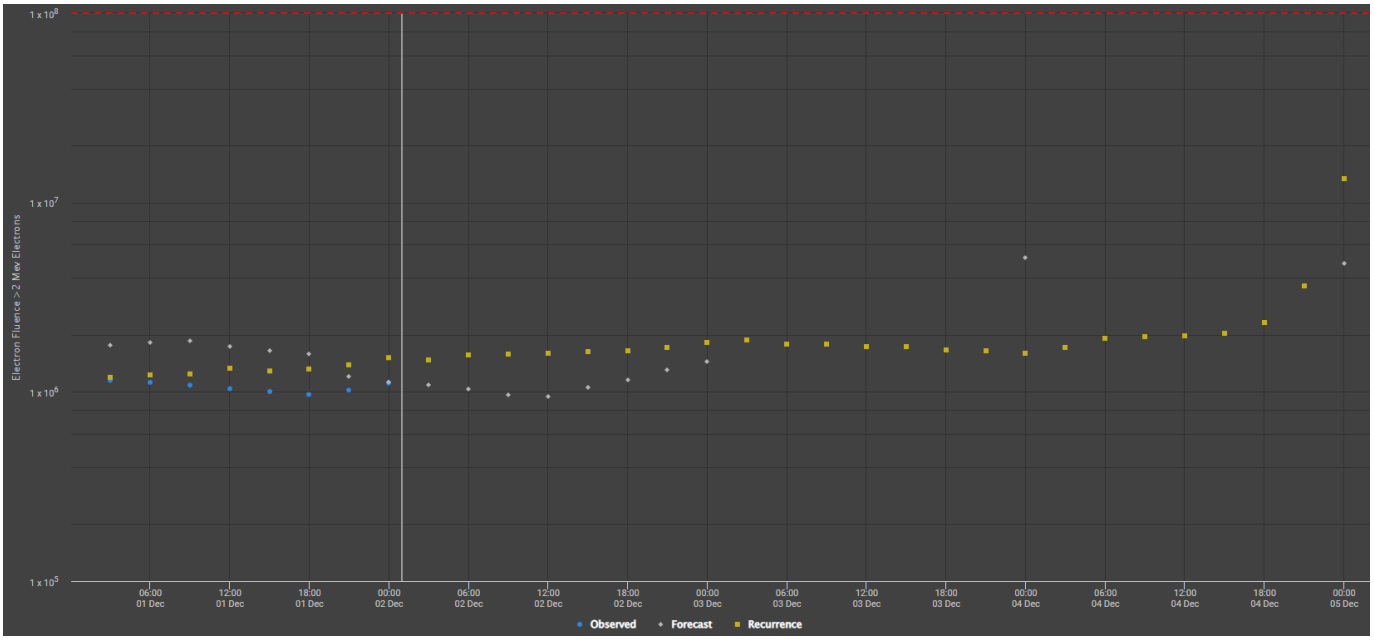
High Energy Electrons (≥ 2MeV)

High energy Electron flux observed by GOES-16 is at Background. This is expected to persist, with no significant coronal hole or CME enhancements currently anticipated during the forecast period.

The associated 24 hr fluence is expected to persist below Active levels, with MOSWOC REFM currently considered to be providing good guidance.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: Latest MOSWOC REFM model output.



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